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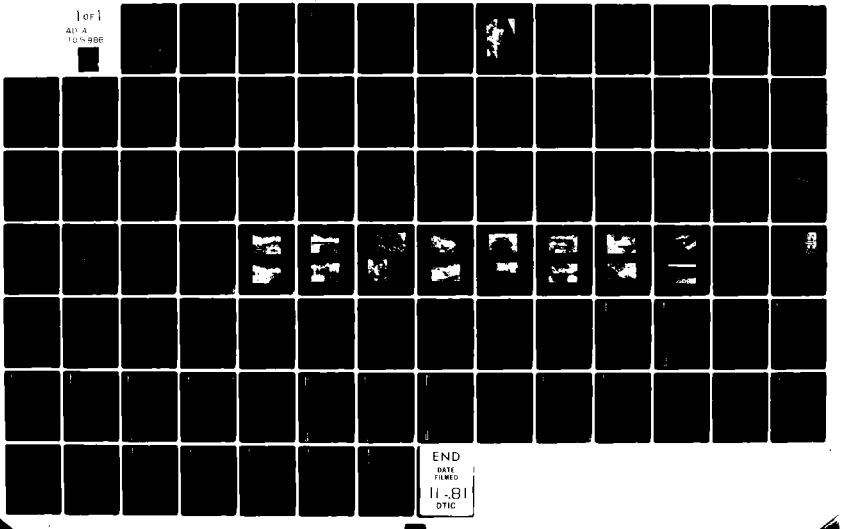

MISSISSIPPI - SALT - QUINCY RIVER BASIN

MISSOURI POWER AND LIGHT DAM

AUDRAIN COUNTY, MISSOURI

MO 10065

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Missouri Power and Light Dam (MO 10065),
Mississippi - Salt - Quincy River Basin,
Audrain County, Missouri. Phase I Inspection
Report.

Final rept.

15 DACW43-78-C-0160

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Missouri Power and Light Dam (Mo. 10065), Phase I Inspection Report

This report presents the results of field inspection and evaluation of Missouri Power and Light Dam (Mo. 10065).

The St. Louis District has classified this dam as unsafe, emergency, requiring immediate attention because of heavy brush and tree growth on the downstream embankment slope, the excessively steep and sloughing downstream embankment slope, seepage on the downstream embankment slope and at the toe of the dam, and a seriously inadequate spillway which will pass only 17 percent of the Probable Maximum Flood.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 5 JAN 1979 (Date)

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 8 JAN 1979 (Date)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Missouri Power and Light Dam, Inv. No. 10065
State Located:	Missouri
County Located:	Audrain
Stream:	Unnamed Tributary of North Fork of Salt River
Date of Inspection:	September 29 and 30, 1978

Missouri Power and Light Dam No. Mo.10065 was inspected using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Four houses, one church and related buildings, three County roads, and one U.S. highway would be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Missouri Power and Light Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Missouri Power and Light Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Missouri Power and Light Dam is a small size dam with a high hazard potential required by the guidelines to pass from one-half Probable Maximum Flood to the Probable Maximum Flood without overtopping. Since there is significant hazard potential downstream of the dam, the appropriate spillway design flood for this dam is a flood somewhat greater than one-half of the Probable Maximum Flood. It was determined that the spillway will pass 17 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation indicates that the spillway will pass the 100-year flood; that is, a flood having a 1 percent chance of being equalled or exceeded during any given year.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region.

Other deficiencies noted by the inspection team were the questionable stability of a recently repaired section of the embankment; large trees and brush on the downstream embankment slope; an unstable upstream embankment slope; extensive rodent activity on the embankment; deteriorated concrete in the spillway structure; obstructions in the downstream discharge channel; a need for an annual inspection by a qualified engineer; and lack of a maintenance schedule. The lack of stability and seepage analysis on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

MISSOURI POWER AND LIGHT DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Missouri Power and Light Dam, I.D. No. 10065

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NATIONAL DAM SAFETY PROGRAM

MISSOURI POWER AND LIGHT DAM, Missouri Inv. No. 10065

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for the Missouri Power and Light Dam was carried out under Contract DACW 43-78-C-0160 to the Department of the Army, St. Louis District, Corps of Engineers, by the engineering firms of Consoer, Townsend & Associated Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of the Missouri Power and Light Dam was made on September 29, and September 30, 1978. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to north abutment or side, and right to the south abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D. These guidelines were developed with the help of Federal agencies and many state agencies, professional engineering organizations, and private engineers".

1.2 Description of the Project

a. Description of Dam and Appurtenances

The dam embankment is a homogeneous earthfill structure. The crest of the dam typically has a width of 14-feet, and a length of approximately 637 feet. The crest elevation is set at 795.67 feet above MSL, and the maximum height of the embankment is approximately 26 feet above the minimum streambed elevation.

The upstream slope of the embankment is vertical for the top 4 feet. This vertical section of embankment is protected by a wall constructed of loose blocks of used concrete and rocks. These blocks are typically 6-inches high by 2-feet thick. Below the top 4 feet, the embankment has an unprotected slope of approximately 1V to 3H to the base of the dam.

The downstream embankment slope is protected by heavy vegetation, and has a typical slope of 1V to 1-1/2 to 2H. This slope is very uneven and irregular.

No information is available regarding the embankment material. Field inspection demonstrated the material to be low plastic clay with traces of silt and sand. The material would be classified as CL by the Unified Soil Classification System.

Bedrock within the vicinity is composed of cyclic deposits, including limestones of Pennsylvanian age. The soils of the area in which this dam is located are considered to be mixed glacial outwash, modified with loessial deposits, further modified by weathering. No bedrock crops out over the

site, and data is not available to describe the foundation conditions or preparation previous to placement of the embankment.

The uncontrolled concrete spillway is located on the left abutment of the embankment near the Lake View Road. The spillway consists of a concrete broad crested weir section, a concrete drop section with five steps, and a concrete apron at the end of the drop structure before entering the downstream channel. The spillway crest length is 46 feet, and the broad crest width is 6 feet. The drop section has five steps; each step drops 3 feet, except the last step which drops only 2 feet. Total length from the crest to the spillway floor apron is 21 feet, 4 inches. The apron length is 22 feet. A cross-section of the spillway is given in a plate in this report.

Except for the spillway, there is no gravity flow outlet from the reservoir. A pump station adjacent to the reservoir provides the only permanent means for drawing down the reservoir. The station contains one small pump (approximately 4-inch discharge), which is occasionally operated to supply make-up water to the cooling tower of a nearby steam-electric plant. The pump suction draws water from a supply sump constructed on the bank of the reservoir. The sump is concrete, about 12 feet in diameter, and fitted with a heavy wooden cover. The cover contains a hinged inspection door which is padlocked for security.

A representative of the owner reported that the supply sump is connected to the reservoir through one or two intake pipes which extend into the reservoir.

The reservoir for Missouri Power and Light Dam impounds 224 acre-feet of water from a drainage area of 1.20 square miles. The reservoir is located in an urban area of Mexico, Missouri, surrounded by roads and two parks.

b. Location

The Missouri Power and Light Dam is located on an unnamed tributary of the North Fork of the Salt River, Audrain County, Missouri. The nearest community downstream of the dam is Mexico, Missouri. A church and associated buildings are located immediately downstream of the dam. The dam and reservoir is shown on Mexico West Quadrangle sheet (7.5 minute series) in Section 35, Township 51 North, Range 9 West.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Small" since its storage is less than 1,000 acre-feet. The dam is also classified as "Small" in dam size category because its height is less than 40 feet. The overall size classification is, accordingly, "Small" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with the classification. The estimated damage zone extends two miles downstream of the dam. Within the damage zone are

four houses, one church and related buildings, three county roads, and one U.S. highway.

e. Ownership

Missouri Power and Light Dam is is owned by the Missouri Power and Light Company, 101 Madison Street, Jefferson City, Missouri 65101.

f. Purpose of Dam

The main purpose of the dam is to impound water for use in a cooling water system for power plants operated by the Missouri Power and Light Company. The reservoir is also used for recreational purposes.

g. Design and Construction History

Design and construction history of the dam is very incomplete. According to the owner, the dam was designed and built prior to 1910, possibly as early as 1885. In 1911, the original spillway washed out and was replaced with the present structure.

Recent work at the dam has included repair of a leak through the embankment section in July, 1978.

h. Normal Operational Procedures

The dam is used to impound water for use as cooling water for a power plant, and for recreation. The reservoir level is controlled by rainfall, runoff, evaporation, and the water supply requirements of the power plant. The reservoir remains close to full at all times.

1.3 Pertinent Data

a. Drainage Area — 769 acres

b. Discharge at Damsite — All discharge at the damsite is through an uncontrolled spillway

Estimated experienced maximum flood:	340 cfs
Estimated ungated spillway capacity at maximum pool elevation:	867 cfs

c. Elevation (Feet above MSL)

Top of dam:	795.67
Spillway crest:	792.0
Minimum streambed elevation at centerline of dam:	769.0
Maximum tailwater:	Unknown

d. Reservoir

Length of maximum pool:	2,700 feet ±

e. Storage (Acre-Feet)

Top of dam:	330

f. Reservoir Surface (Acres)

Top of dam:	30
Spillway crest:	28

g. Dam

Type:	Earth embankment
Length:	637 feet
Height (maximum):	26 feet
Top width:	Varies - 14 feet typical

Side slopes:	
Downstream	1V to 1-1/2 to 2H
Upstream	Vertical for top 4 feet, 1V to 3H for remainder of slope to ground surface
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel — None

i. Spillway

Type:	Uncontrolled
Length of weir:	46 feet
Crest Elevation:	792 feet (MSL)

j. Regulating Outlets — None

A pump station adjacent to the reservoir can draw water from the reservoir.

SECTION 2: ENGINEERING DATA

2.1 Design

No design data is available for the dam and appurtenant structures. A plate was made for this report, based upon visual observations and measurements made during the field inspection.

2.2 Construction

The only construction data available is a Missouri Public Service Commission inventory which provides some basic information concerning the dam. In this inventory, the dam is described as "earthfill constructed of Dry earth borrow from reservoir site put in place by teams". A representative of the owner indicated that construction was "sometime before 1910, and probably about 1885."

Reconstruction of the dam included replacement of the original spillway which was washed out during a flood in 1911. Also, a section of embankment exhibiting a leak was repaired in July, 1978.

2.3 Operation

No operation records for Missouri Power and Light Dam are available.

2.4 Evaluation

a. Availability

Essentially, no information is available for the dam and appurtenant structures. The inventory data on the dam is the only available information.

No pertinent data was available for review of hydrology, spillway capacity, flood routing through the reservoir, outlet capacity, slope stability, seepage analysis, or foundation conditions.

b. Adequacy

The engineering data available is inadequate to aid in evaluating the hydraulic and hydrologic capabilities and stability of the dam for Phase I investigations. The owner should have a survey performed and an as-built set of drawings made for the dam and appurtenant structures.

The lack of engineering data, other than design drawings, did not allow for a definitive review and evaluation. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design and construction, but is based primarily on visual inspection with the aid of the available design drawings, past performance history, and sound engineering judgment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity

The only available information, the dam inventory listing, is of questionable validity since it was likely made well after the original construction.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of Missouri Power and Light Dam was made on September 29, and September 30, 1978. The following persons were present during the inspection:

Name	Affiliation	Discipline
Yin Au-Yeung	Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
David Bramwell	Engineering Consultants, Inc.	Geology
Jon Diebel	Engineering Consultants, Inc.	Soils & Stability
John Ismert	Engineering Consultants, Inc.	Mechanical
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil & Structural

Specific observations are discussed below.

b. Dam

The crest of the dam is adequately protected by a heavy vegetative cover. The upstream slope of the embankment is in deteriorated condition. The wall constructed of loose blocks of used concrete and rocks is unstable in many places, appearing to be on the verge of failing into the reservoir. Cracking, indicating movement, can be seen behind the wall in several areas. Extensive rodent activity is occurring on the upstream slope and crest. Several large holes could be seen which are likely occupied by muskrats. Shells of fresh water

clams could be seen along the upstream slope of the embankment, confirming the presence of muskrats.

The downstream slope of the embankment is also in deteriorated condition. Heavy brush and tree growth is present on the slope. The heavy vegetation made it difficult to inspect the embankment slope, but several areas were moist and contained vegetation indicating potential seepage. The slope itself is very steep, and sloughing was prevalent. The slope is generally uneven and irregular.

One section of the embankment has been recently repaired, located approximately 125 feet from the right abutment. A leak had developed on the downstream embankment slope, and attempts to repair the leak by addition of material to the upstream embankment slope proved unsuccessful. The reservoir was then lowered several feet, and a section of embankment 4-feet wide by 8 to 10-feet deep was excavated. The excavated section was then replaced with a mixture of nearby clay and "fireclay". A representative of the owner indicated that compaction was achieved with the bucket of the backhoe, and visual inspection did not reveal the compaction to be satisfactory.

In the foundation materials adjacent to the toe of the downstream embankment slope, ponds of water, phreatophytes, and desiccation cracks, trending normal to the dam axis, were prevalent. These observations were seen mostly on either side of the former channel section. Telephone poles were observed downstream of the toe of the dam on the upstream slope of the embankment, and in close proximity to the spillway discharge channel.

c. Appurtenant Structures

(1) Spillway

The concrete in the spillway structure is in deteriorated condition. Heavy vegetative growth was noted on the left side of the approach channel. Erosion, spalling, and cracks in concrete were noted in the structure. The downstream channel is obstructed by fallen tree trunks and debris, and the channel banks show signs of erosion and sloughing.

(2) Pumping Plant

The interior of the pumping station and the pump were inspected. The station is also used as a storage building. The station is clean and, considering its age, in reasonably good condition. Since the pump is used only intermittently, the station is normally unattended and locked. The most recent operation of the pump was in the spring of 1978. The supply sump was inspected; its water surface was clean. The intake pipes were not observed since they are under water.

d. Reservoir Area

The water level was at elevation 790.58 feet above MSL at the time of the inspection.

There have been no apparent changes in the drainage basin that would affect the runoff characteristics, or the stability of the reservoir rim, since the dam was constructed. The watershed is in an urbanized area, and the reservoir shoreline is a City Park which is very well maintained.

e. Downstream Channel

The downstream channel has not been adequately maintained. Tree trunks and debris were observed within 200 feet downstream of the spillway. The downstream channel has been moderately eroded during past floods. Signs of sloughing were noted on the bank slopes. The channel cross-section immediately downstream from the spillway is trapezoidal in shape, with a bottom width of 10 feet, and side slopes of 1V to 2H. The channel runs along the parking lot of the Luthern Church, and through a 8' x 13'-4" culvert under U.S. Highway 54.

3.2 Evaluation

A large number of observations were made at Missouri Power and Light Dam which could affect the safety of the dam, and which will require remedial measures, monitoring, or maintenance in the near future. These items include:

1. The deteriorated condition of the upstream embankment slope.

2. The extensive rodent activity occurring in the embankment section.

3. The heavy brush and tree growth on the downstream embankment slope.

4. The steep and sloughing downstream embankment slope, which includes a poorly repaired section of embankment.

5. The seepage observed downstream of the toe of the embankment demonstrated by ponds, phreatophytes, and desiccation cracks.

6. The deteriorated condition of the concrete spillway.

7. The condition of the downstream channel of the spillway, which contains tree trunks and other obstructions. Also, erosion and sloughing is occurring on the channel banks.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Missouri Power and Light Dam is used to impound water from an unnamed tributary of the North Fork of the Salt River. The water is used for cooling water for a power plant, and the reservoir is also used for recreation. The only operating facility at the damsite is the pump station adjacent to the reservoir. Water required by the power plant is pumped from the reservoir to the plant.

4.2 Maintenance of the Dam

The dam is maintained by Missouri Power and Light personnel. Maintenance, however, is poor at the damsite. The dam and appurtenant structures are in a deteriorated condition due, primarily, to lack of maintenance. Some of the observations of conditions requiring remedial measures are given in Section 3.2 of this report.

4.3 Maintenance of Operating Facilities

The interior of the pumping station and the pump were inspected. The station is also used as a storage building. The station is clean and, considering its age, in reasonably good condition. Since the pump is only used intermittently, the station is normally unattended and locked. The most recent operation of the pump was in the spring of 1978. The supply sump was inspected; its water surface was clean. The intake pipes were not observed since they are under water.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any existing warning system for this dam.

4.5 Evaluation

Maintenance of the dam and appurtenant structures is very poor. The embankment section and spillway is in a badly deteriorated condition, and remedial measures will be required. No problems are apparent with the operating procedures at the damsite.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

Missouri Power and Light Dam has a watershed of approximately 769 acres. This area is approximately 5 percent covered with brush and forest. Land gradients average about 1.5 to 2.5 percent.

Elevations within the watershed range from approximately 792 feet above MSL at the damsite to over 835 feet above MSL in the upper portion of the watershed.

A drainage map showing the watershed area is included in Appendix B.

Evaluation of the hydraulic and hydrologic features of Missouri Power and Light Dam was based on criteria set forth in the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in EM 1110-2-1411 (Standard Project Storm). The SCS triangular hydrograph, transformed to a curvilinear hydrograph, was adopted for developing the unit hydrograph. The derived unit hydrograph is presented in Appendix B.

Initial and infiltration loss rates were applied to the PMP to obtain rainfall excesses. The rainfall excesses were then applied to the unit hydrograph to obtain the PMF hydrograph, utilizing the Corps of Engineers' computer program HEC-1, (Dam Safety Version), which was prepared specifically for dam safety analysis. The computed peak discharge of the PMF and one-half of the PMF are 8,551 cfs and 4,276 cfs, respectively. The spillway hydraulic capacity just before overtopping of the dam is 867 cfs.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method, also utilizing the HEC-1 (Dam Safety Version) computer program. The peak outflow discharges for the PMF and one-half of the PMF are 7,854 cfs and 3,927 cfs, respectively. Both the PMF and one-half of the PMF, when routed through the reservoir, resulted in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes and sketches. The reservoir stage-capacity data were based on the U.S.G.S. quadrangle topographic maps in combination with data given in the National Dam Safety Inventory Table. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway overtop rating curve assumed that the dam remains intact during routing. In the routing computations, the discharge through the outlet facilities was excluded due to its insignificant magnitude as compared to the spillway discharge and the PMF. The spillway rating curve and the reservoir capacity curve are also presented in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam aims at avoiding overtopping. Overtopping is especially dangerous for an earth dam because the downrush of waters over the crest will erode the dam face and, if continued long enough, will breach the dam embankment and release all the stored water suddenly into the downstream floodplain. The safe hydrologic design of a dam calls for a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineers designs its dams to safely pass the Probable Maximum Flood that is estimated could be generated from the upstream watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. Although dams that do not fully meet this standard will not be evaluated as "unsafe", the Corps considers the minimum hydrologic requirement for safety for this dam to be the capability to pass one-half of the Probable Maximum Flood without overtopping.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, according to interviews with local residents, the maximum reservoir level was never higher than the crest of the embankment.

c. Visual Observations

The entire structure demonstrates a lack of adequate maintenance. Concrete in the spillway is in a deteriorated condition. Severe erosion and spalling, as well as diagonal cracks were observed in the spillway structure. Debris and aquatic growth were noted in the spillway approach channel. The downstream channel has not been adequately maintained, and the channel banks show signs of instability. The downstream channel is not capable of passing the SDF without overtopping the channel banks.

d. Overtopping Potential

As indicated in Section 5.1-a., both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The PMF and one-half of the PMF overtopped the dam crest by 2.31 feet and 1.12 feet, respectively. The total duration of embankment overflow is 6.10 hours during the PMF, and 4.20 hours during one-half of the PMF. The spillway of the Missouri Power and Light Dam is capable of passing a flood equal to approximately 17 percent of the PMF just before overtopping the dam. The 100-year flood is equal to approximately 9 percent of the PMF, therefore, the spillway will pass the 100-year flood without overtopping of the dam. Since one-half of the PMF is the minimum Spillway Design Flood (SDF) for Missouri Power and Light Dam, according the the Recommended Guidelines for Safety Inspection of Dams by the Corps, the spillway capacity of the dam is considered "Inadequate".

The effect from rupture of the dam could extend approximately two miles downstream of the dam. There are four farmhouses, one church and related buildings, three county roads, and one U.S. highway within the four miles of floodplain area.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The following visual observations affect the structural stability of the dam embankment.

1. Lack of proper compaction of the reconstructed embankment section.

2. Steep downstream slope which is overgrown with brush and trees. Also, some indication of seepage is present on the slope, but is hard to identify due to heavy vegetation.

3. Generally unstable rock wall protecting the upstream slope.

4. Extensive rodent activity throughout the embankment section.

5. Indications of seepage on the downstream embankment slope and below the toe of the dam in various areas.

6. The deteriorated condition of the concrete spillway. This spillway section washed out once in 1911.

No problems exist with the pumping plant which affect the structural stability of the dam.

b. Design and Construction Data

No design or construction data relating to the structural stability of the dam or appurtenant structures are available. The design data relating to seepage and stability analyses are known to exist.

c. Operating Records

No operating records are available relating to the stability of the dam or appurtenant structures. The reservoir had not yet refilled following the repair work done in July, 1978, on the embankment section. Normal operation of the reservoir would have the water level close to full at all times.

d. Post Construction Changes

Work performed after the original construction included reconstruction of a washed out spillway in 1911, and the recent repair to the embankment section.

e. Seismic Stability

In general, projects located in Seismic Zones 0, 1 and 2 can be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist. Missouri Power and Light Dam is located in Seismic Zone 1. A detailed seismic analysis is not felt to be necessary for this embankment.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that an unsafe condition could be detected.

a. Safety

The overall safety of Missouri Power and Light Dam is considered poor. The spillway capacity was found to be seriously inadequate. The spillway is capable of passing a flood equal to only 17 percent of the PMF. In addition, the embankment is in a deteriorated condition. The downstream embankment slope is generally very steep, and exhibits sloughing in many areas. Some seepage ponds and phreatophytes were observed downstream of the toe of the dam in the vicinity of

the former river channel. Also, vegetation, indicating moisture, was observed on the downstream slope itself in many areas. A large amount of trees and brush cover the slope, making proper inspection virtually impossible. The upstream slope is protected by an unstable 4-foot high rock wall, which has failed in several areas, and appears to be on the verge of failure in other areas.

The repaired section of embankment is of questionable stability. The compaction of the earthfill is likely not satisfactory, based on visual observation and the reported method of compaction. The section was also replaced with a steep slope corresponding to the remainder of the embankment. A rodent hole was reported to be the cause for the leak which initiated the repairs. Rodent activity is prevalent on the embankment.

The concrete spillway structure is also in deteriorated condition. A large amount of cracking, spalling and erosion was observed on the concrete slab and walls. The spillway washed out in 1911, and was replaced with the current structure at that time.

The questionable safety of this dam is compounded by the serious hazard potential downstream of the embankment. The reservoir and dam is located in an urban area, with a church, houses and 4 roads located downstream of the dam.

b. Adequacy of Information

Information concerning operation and maintenance of the dam and appurtenant structures is lacking. It is recommended that the following programs be initiated to help alleviate this problem:

1. Annual inspection of the dam by a professional engineer experienced in the design and construction of earthen dams should be made and this report made a matter of record.

2. Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

3. Assemble and keep on hand complete documentation of the dam design, as-built drawings, and any other data pertaining the the dam safety.

4. Seepage and stability analyses comparable to the requirements of the "Recommended Guidlines for Safety Inspection of Dams".

c. Urgency

The remedial measures recommended in Paragraph 7.2 should be accomplished in the near future.

Increasing the spillway capacity and performing the embankment stability study is more urgent nature than the other recommended actions.

d. Necessity for Phase II Inspection

Based on results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken as soon as possible, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

Possible alternatives for increasing the spillway capacity of the dam include:

1. Widening the existing spillway.

2. Lowering the existing spillway.

3. Raising the dam crest.

4. Combination of above.

A comprehensive stability study of the embankment section is recommended. This study should include determination of the embankment cross-section by survey, drilling of test holes into the embankment and foundation to provide information about the embankment and foundation condition and, possibly, the installation of piezometers to locate the phreatic line for the embankment section. The study should also analyze the recently repaired section of embankment in detail, with recommendations.

b. O & M Maintenance Procedures

The owner should initiate the following programs:

1. Annual inspection of the dam by a professional engineer experience in the design and construction of earthen dams.

2. Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

3. Assemble and keep on hand complete documentation of the dam design, as-built drawings, and any other data pertaining to the dam safety.

4. Clear large trees and brush from the downstream embankment slope, and prevent future growth by frequent maintenance.

5. Make repairs, as necessary, to the upstream slope, including strengthening areas currently exhibiting instability.

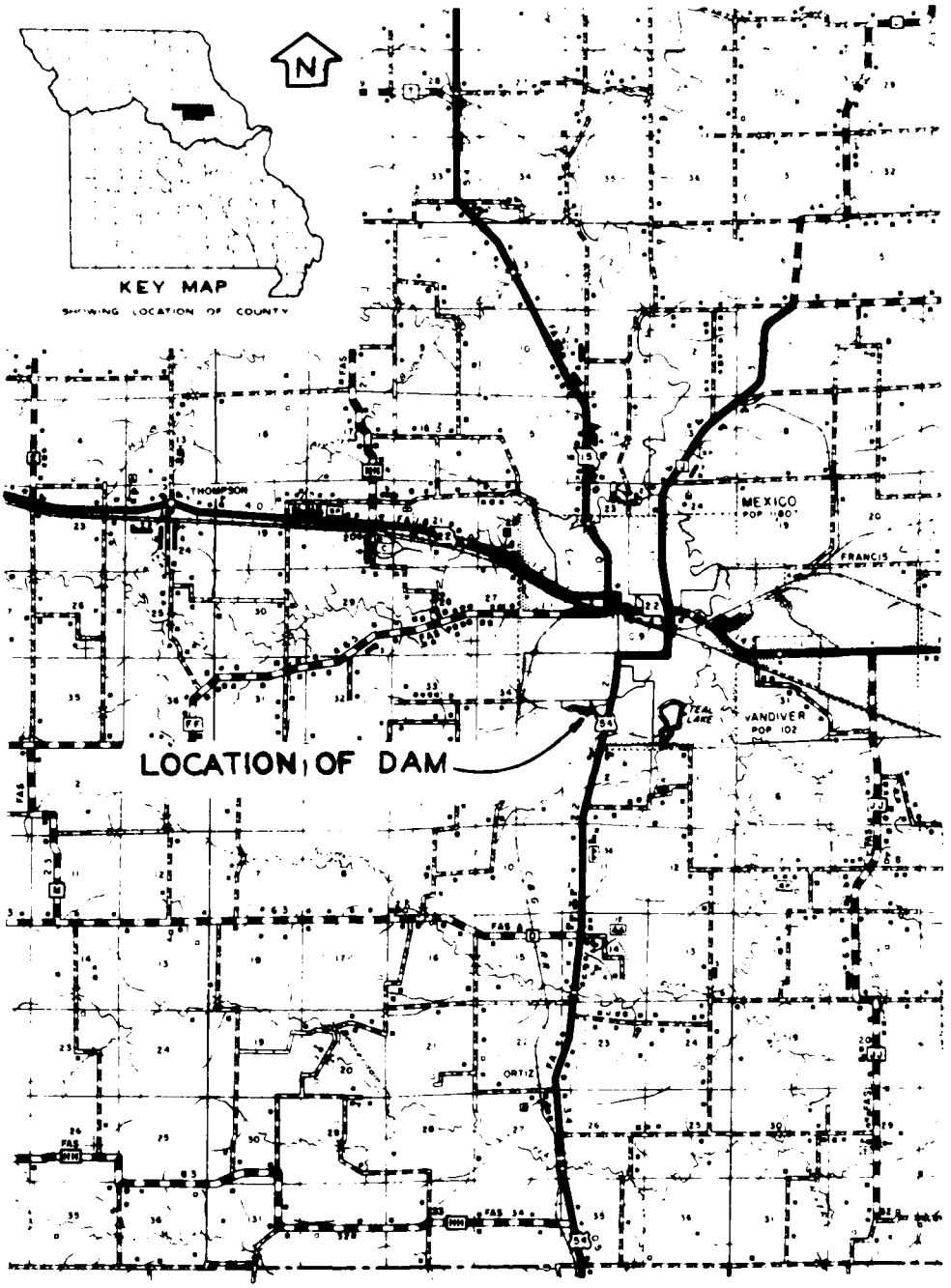
6. Eliminate rodents currently burrowing into the embankment, and fill holes with compacted earthfill to the extent possible.

7. Make repairs to the deteriorated concrete in the spillway structure and stabilize the downstream channel slopes.

8. Clear the obstructions from the downstream channel.

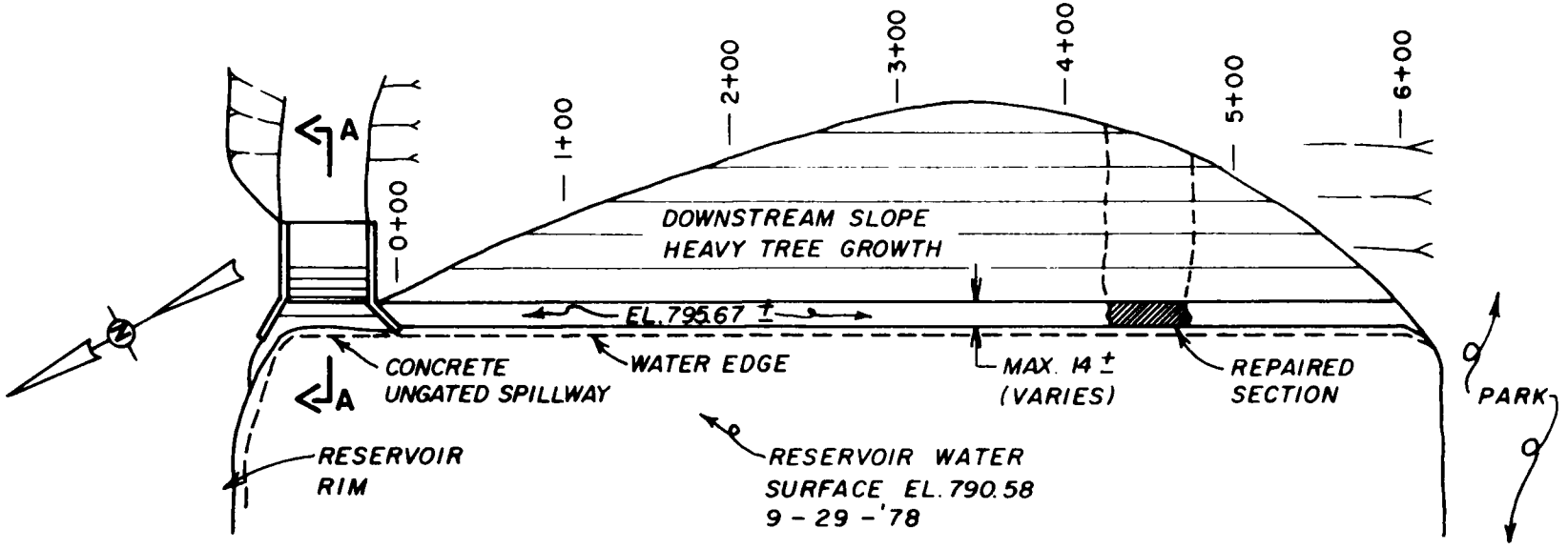
9. Seepage and stability analysis should be performed by a professional engineer experience in the design and construction of dams.

PLATES

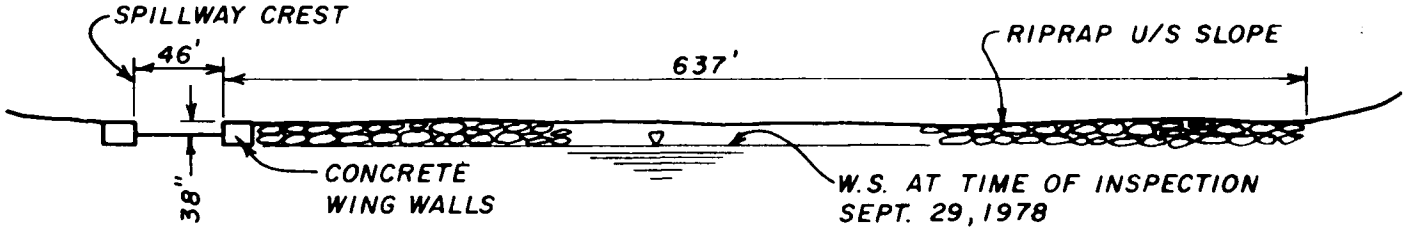


LOCATION MAP
MISSOURI POWER & LIGHT DAM
AUDRAIN COUNTY, MISSOURI

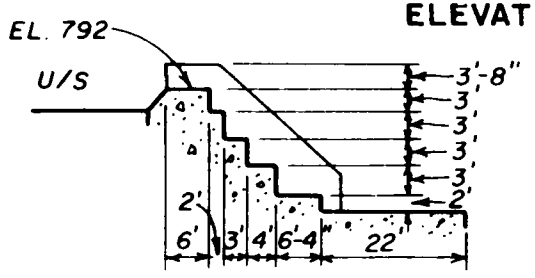
MISSOURI POWER & LIGHT DAM
RELATIVE ELEVATIONS



PLAN

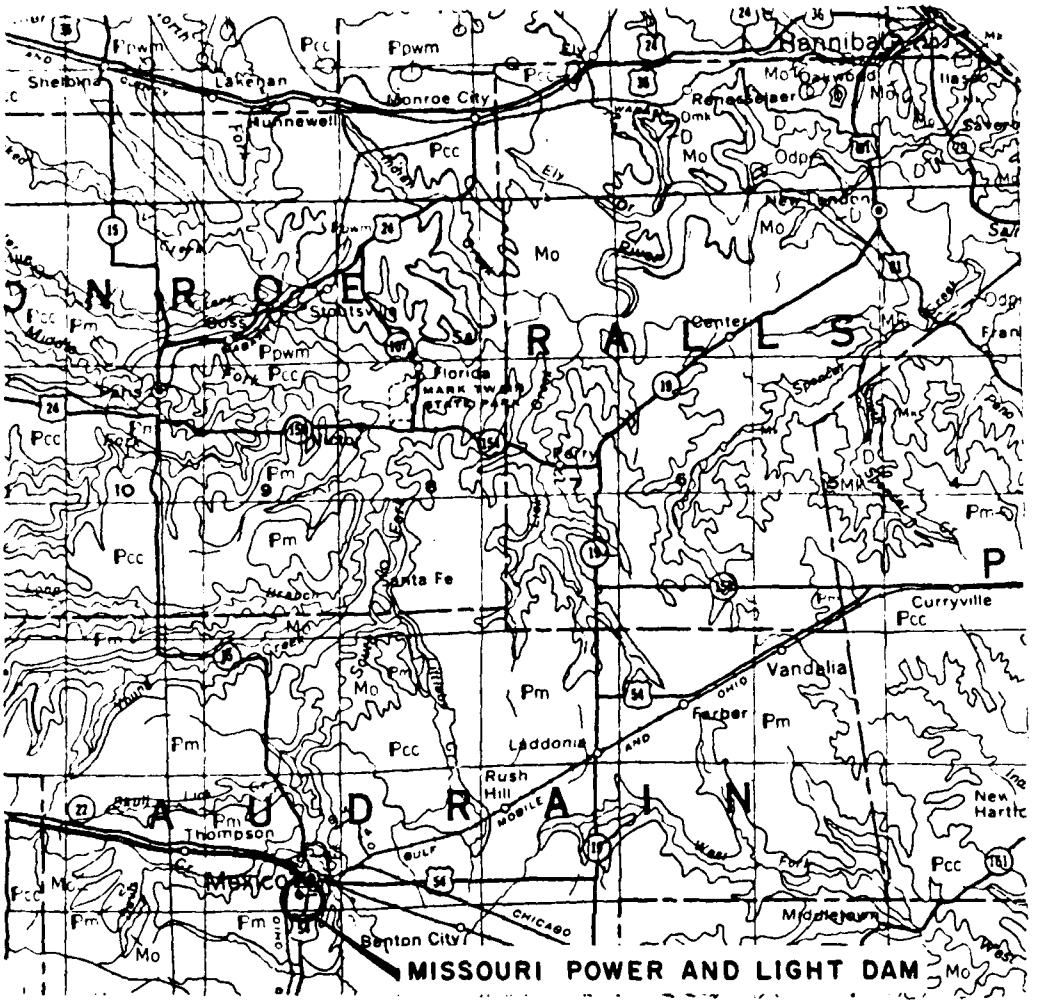


ELEVATION LOOKING DOWNSTREAM



SECTION A-A
(THROUGH SPILLWAY)

SCALE:
1" = 100' (HORIZONTAL)
VERTICAL (NOT TO SCALE)



Explanation

Pennsylvanian System

P_{kc} - Kansas City group: cyclic deposits with numerous limestones.

P_{pwm} - Pleasanton group: sandstone channel member.

P_{m} - Marmaton group: cyclic deposits with limestones.

P_{cc} - Cherokee group: cyclic deposits, predominately shale, sandstone and coal beds.

Mississippian System

M_{m} - sandy, oolitic, fossiliferous, lithographic, or cherty limestones.

M_{o} - cherty, crinoidal limestone, with some shale.

M_{k} - intercalated limestones and shales.

Devonian System

D - limestones and sandstones.

Silurian System

S - limestones with some shale and chert.

Ordovician System

O_{mk} - shale and limestones.

O_{dp} - shale with thin fossiliferous limestone beds and dense limestone.

Reference: Geologic Map of Missouri, 1961, Division of Geological Survey and Water Resources, State of Missouri.

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

MISSOURI POWER AND LIGHT DAM

Photo 1 - View along crest of dam taken near left side of dam.

Photo 2 - View along upstream slope of embankment taken at left abutment of dam.

Photo 3 - Picture of typical section of upstream embankment slope near left side of dam.

Photo 4 - Picture of upstream embankment slope taken on upstream slope near center of dam.

Photo 5 - Close-up of section of upstream embankment slope exhibiting sloughing.

Photo 6 - Picture of rodent hole behind blocks on upstream embankment slope.

Photo 7 - Picture of rodent hole behind blocks on upstream embankment slope.

Photo 8 - Picture of downstream embankment slope taken downstream of dam near right abutment.

Photo 9 - Picture of repaired embankment as seen on dam crest.

Photo 10 - Picture of repaired section of embankment taken from crest looking downstream.

Photo 11 - Picture of spillway approach channel taken from dam crest.

Photo 12 - Picture of entrance to spillway taken from left abutment of dam.

Photo 13 - Picture of spillway taken from downstream.

Photo 14 - View of spillway discharge channel taken at crest of spillway.

Photo 15 - Close-up of typical cracked areas on the spillway channel side walls.

Photo 16 - Close-up of eroded concrete at upstream end of concrete spillway crest.

Photo 1 - View along crest of dam taken near left side of dam.

Photo 2 - View along upstream slope of embankment taken at left abutment of dam.

Photo 3 - Picture of typical section of upstream embankment slope near left side of dam.

Photo 4 - Picture of upstream embankment slope taken on upstream slope near center of dam.

Photo 5 - Close-up of section of upstream embankment slope exhibiting sloughing.

Photo 6 - Picture of rodent hole behind blocks on up-upstream embankment slope.

Photo 7 - Picture of rodent hole behind blocks on upstream embankment slope.

Photo 8 - Picture of downstream embankment slope taken downstream of dam near right abutment.

Photo 9 - Picture of repaired section of embankment as seen on the dam crest.

Photo 10 - Picture of repaired section of embankment taken from crest looking downstream.

Photo 11 - Picture of spillway approach channel taken from dam crest.

Photo 12 - Picture of entrance to spillway taken from left abutment of dam.

Photo 13 - Picture of spillway taken from downstream.

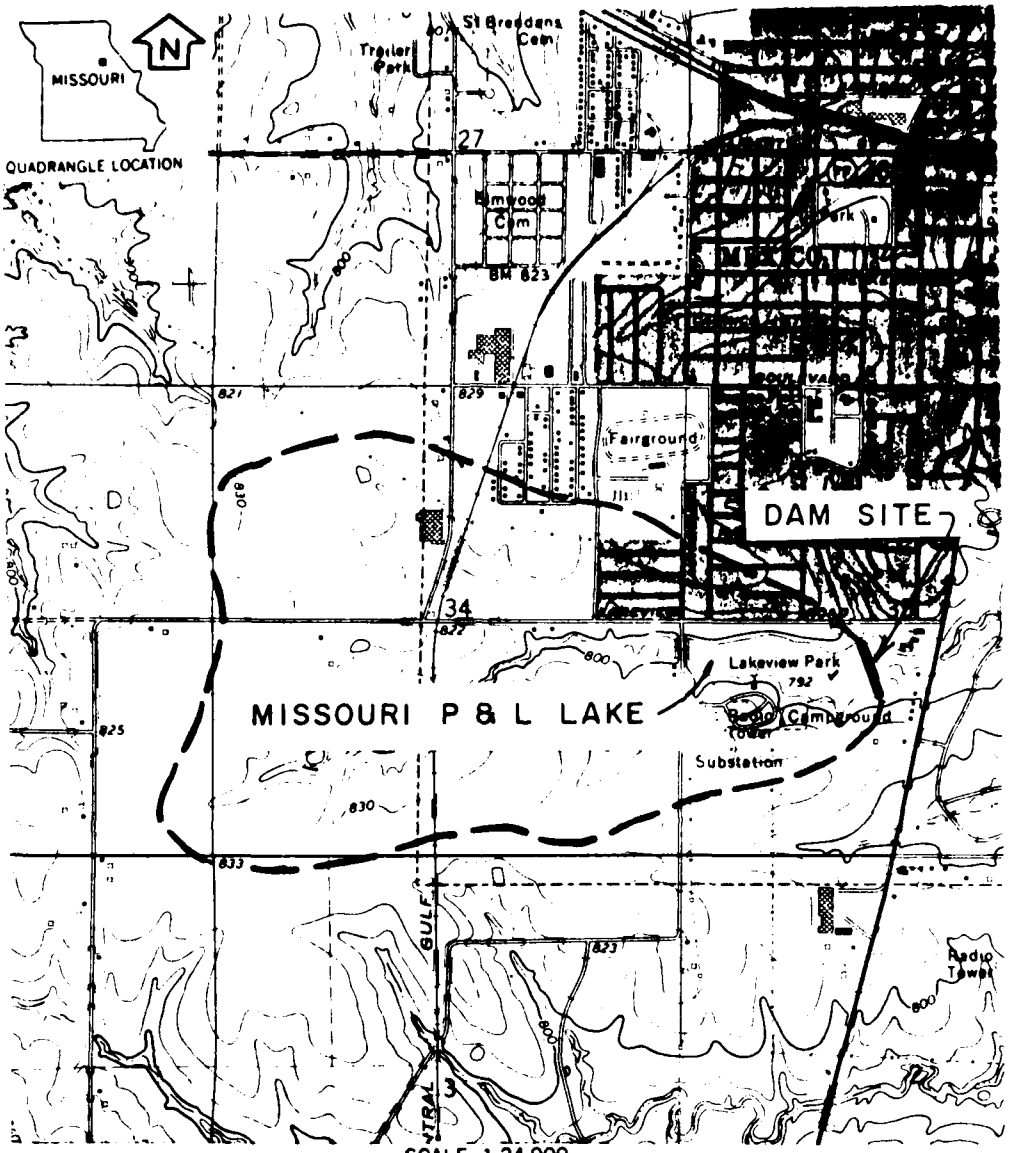
Photo 14 - View of spillway discharge channel taken at crest of spillway.

Photo 15 - Close-up of typical cracked areas on the spillway channel side walls.

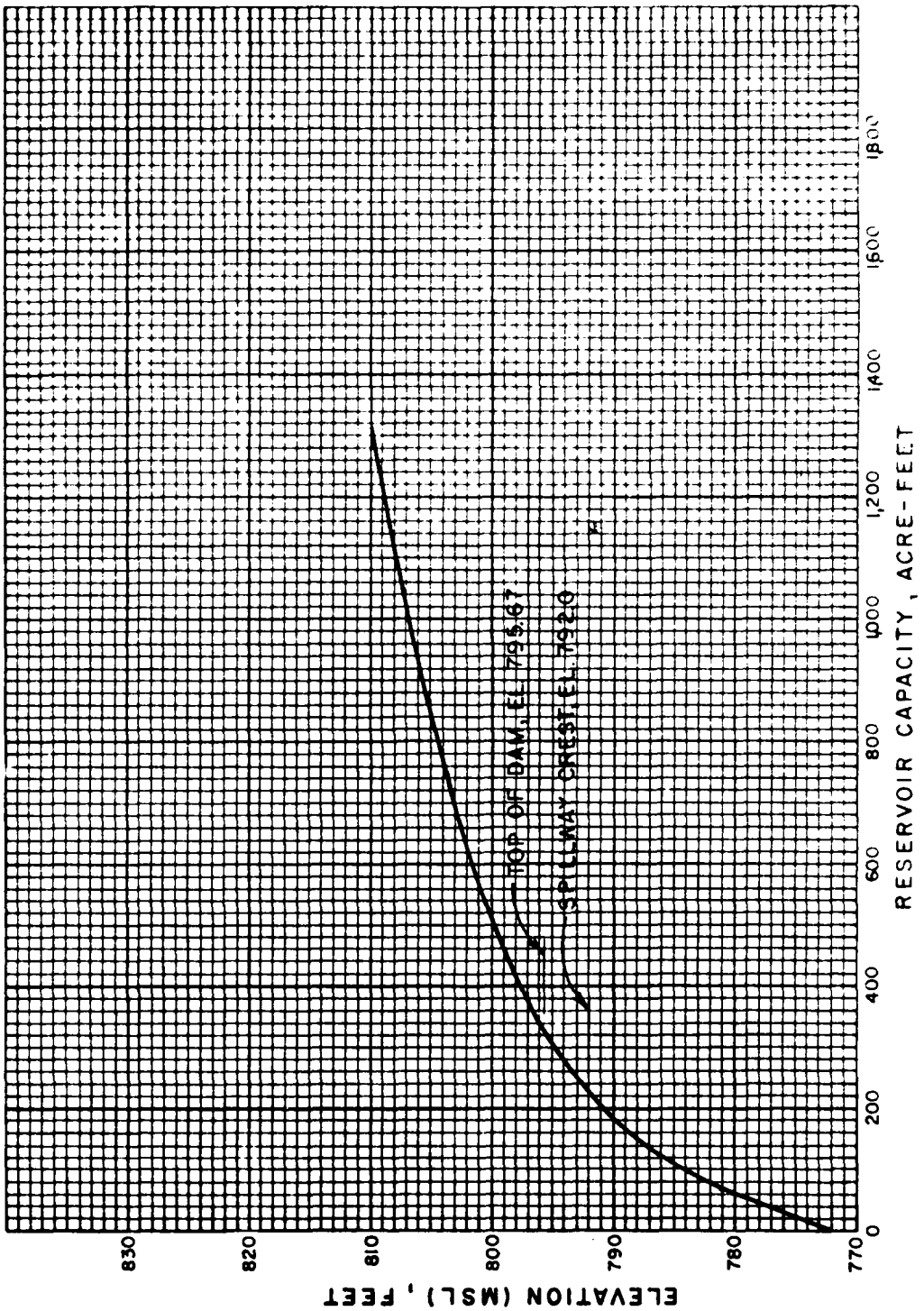
Photo 16 - Close-up of eroded concrete at upstream end of concrete spillway crest.

APPENDIX B

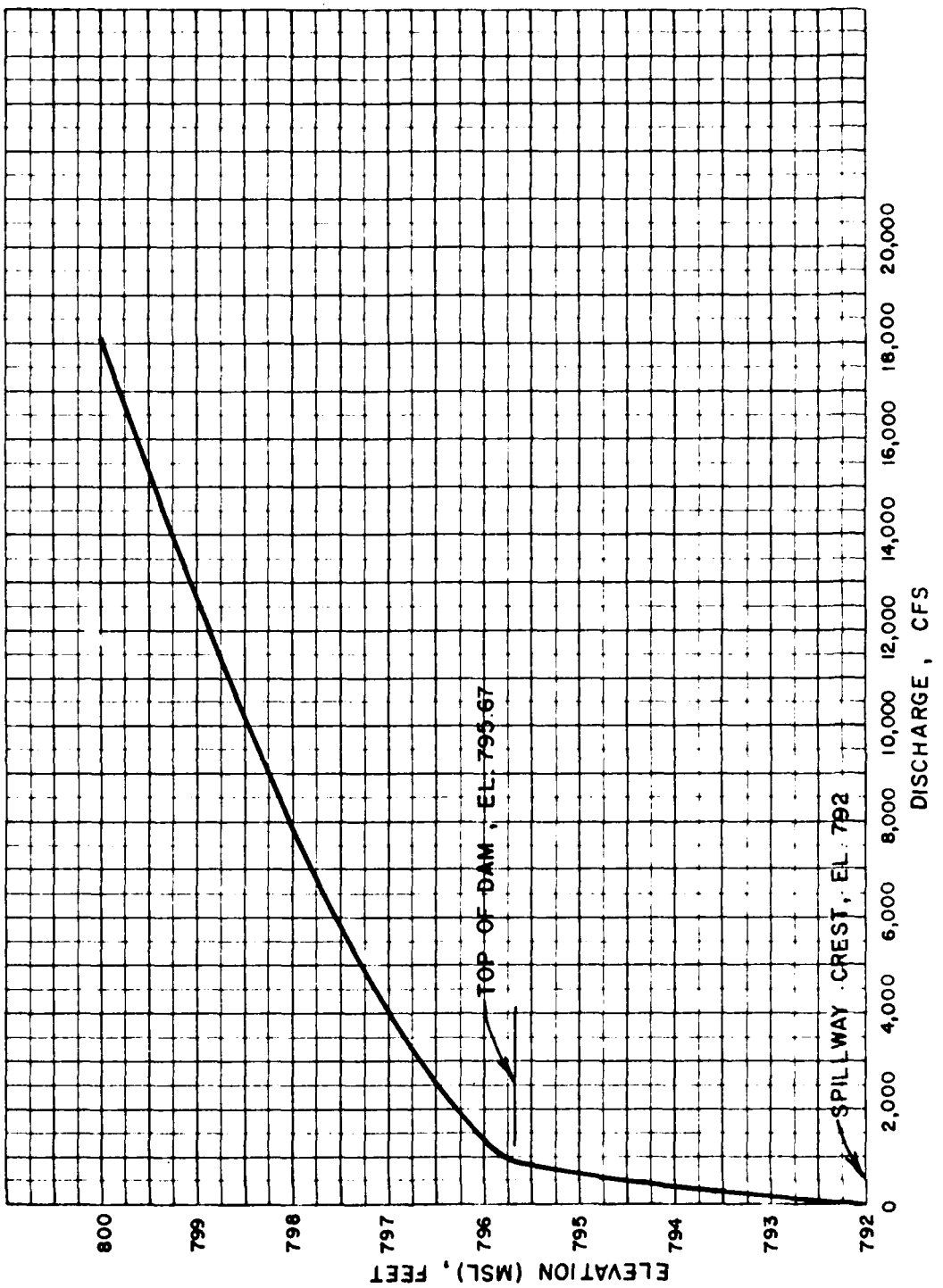
HYDROLOGIC COMPUTATIONS



MISSOURI POWER & LIGHT DAM
DRAINAGE AREA



MISSOURI POWER AND LIGHT DAM
RESERVOIR CAPACITY CURVE



MISSOURI POWER & LIGHT DAM
SPILLWAY & OVERTOP RATING CURVE

ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI — SHEET NO. 1 OF ____
MISSOURI POWER AND LIGHT DAM — JOB NO. 1223-001-1
RESERVOIR AREA CAPACITY — BY KLB DATE 10-11-78

MISSOURI POWER AND LIGHT

RESERVOIR AREA CAPACITY

The data used are based on USGS Mexico West Quadrangle Sheet (7.5 minute Series) in combination with data given in the National Dam Safety Inventory Table.

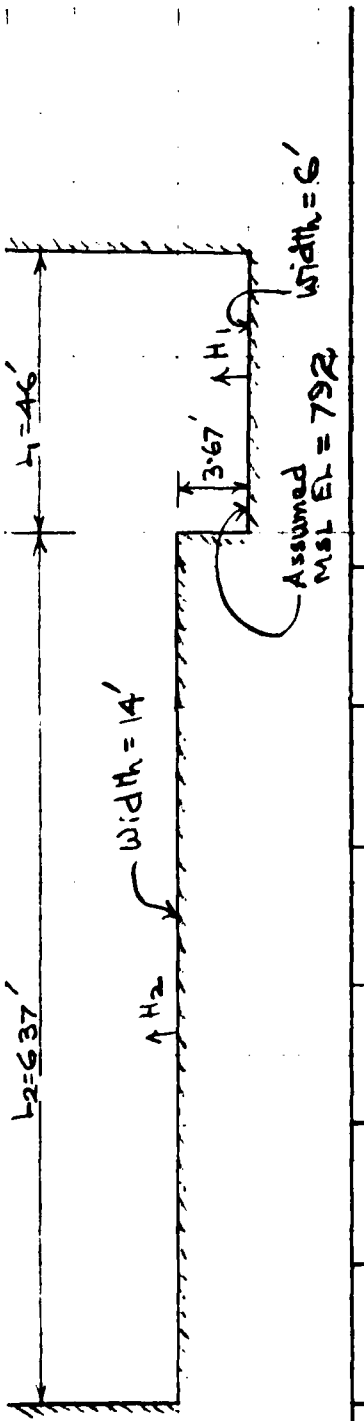
ELEV. M.S.L. (FT)	RESERVOIR SURFACE AREA (ACRES)	INCREMENTAL VOLUME (AC-FT)	TOTAL VOLUME (AC-FT)	REMARKS
772	0	-	0	STREAMBED AT CENTER OF DAM
792	28	224	224	SPILLWAY CREST
795.67	30	106	330	TOP OF DAM
800	49	171	501	
810	112	805	1306	
820	237	1745	3051	

ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF 2

MO. POWER & LIGHT DAM — JOB NO. 1228-001

SPILLWAY & OVERTOP DISCHARGE CAPACITY — BY MAS — DATE 10-10-78



Upstream W.S. El. (ft.)	H_1 (ft.)	H_2 (ft.)	L_1 (ft.)	L_2 (ft.)	C_1	C_2	$Q = \sum_{i=1}^{2} C_i L_i H_i^{1.5}$ (cfs)
792	0						
793	1		46		2.68		123
794	2		46		2.65		345
795.67	3.67	0	46		2.68		867
796	4	0.33	46	637	2.70	2.70	914+326=1320
798	6	2.33	46	637	2.88	2.63	1947+5958=7905
800	8	4.33	46	637	2.88	2.63	2998+15095=18093
805	13	9.33	46	637	2.88	2.63	6210+47744=53954

ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION – MISSOURI — SHEET NO. 1 OF
MISSOURI POWER AND LIGHT DAM — JOB NO. 1223-001-1
UNIT HYDROGRAPH PARAMETERS — BY KLB DATE 9-7-78

1. DRAINAGE AREA = 769 ACRES = 1.20 SQ. MI.

2. LENGTH OF STREAM = L = (3.2" x 2000'/5280') = 1.21 MI.

3. DIFFERENCE IN ELEVATION: ΔH

$\Delta H = 835 - 792 = 43$ FT.

4. TIME OF CONCENTRATION

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times 1.21^3}{43}\right)^{0.385}$$

$T_c = 0.76$ HR.

5. LAG TIME $L_t = 0.6 \times T_c$

$L_t = 0.6 \times 0.76 = 0.46$ HR

6. UNIT DURATION $D \leq \frac{L_t}{3} = \frac{0.46}{3} = 0.15$

USE $D = 0.10$ HR

7. TIME TO PEAK, T_p

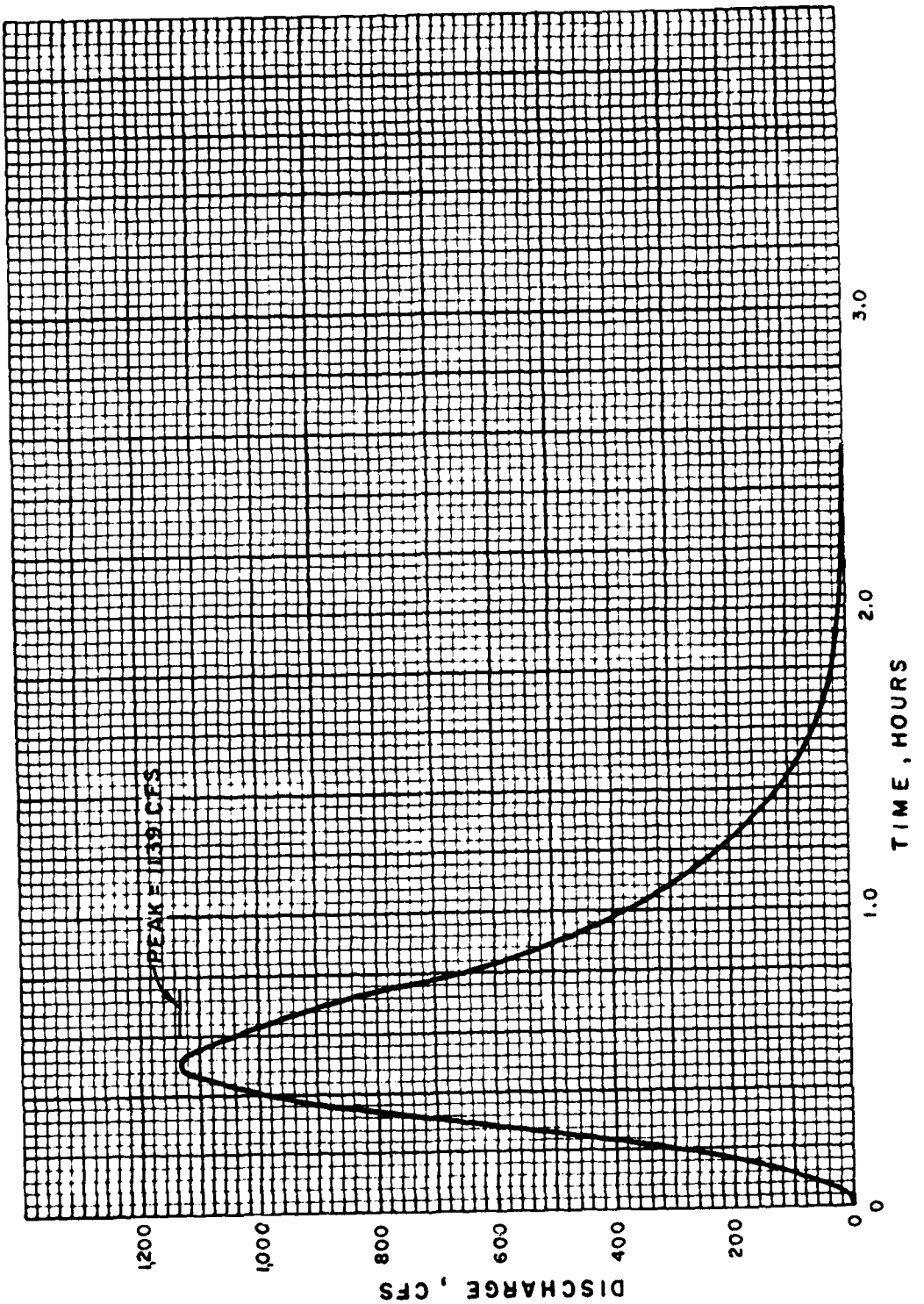
$$T_p = \frac{D}{2} + 0.6 \times T_c = \frac{0.10}{2} + 0.6 \times 0.76$$

$T_p = 0.51$ HR

8. $$q_p = \frac{484 \cdot A}{T_p} = \frac{484 \times 1.20}{0.51} = 1138.82 \text{ CFS}$$

7) CURVILINEAR UNIT HYDROGRAPH

TIME T/Tp	DISCHARGE RATIO Q/Qp	UNIT HYDROGRAPH	
		TIME, T (HOURS)	DISCHARGE (CFS)
0.00	0.000	0.00	0.000
0.1	0.015	0.05	17.08
0.2	0.075	0.10	85.41
0.3	0.16	0.15	182.21
0.4	0.28	0.20	318.87
0.5	0.45	0.26	512.47
0.6	0.60	0.31	683.29
0.7	0.77	0.36	876.89
0.8	0.89	0.41	1013.95
0.9	0.97	0.46	1104.56
1.0	1.00	0.51	1138.82
1.1	0.98	0.56	1116.04
1.2	0.92	0.61	1047.71
1.3	0.84	0.66	956.61
1.4	0.75	0.71	854.12
1.5	0.66	0.77	751.62
1.6	0.56	0.82	637.74
1.8	0.42	0.92	478.30
2.0	0.32	1.02	364.42
2.2	0.24	1.12	273.32
2.4	0.18	1.22	204.99
2.6	0.13	1.33	148.05
2.8	0.098	1.43	111.60
3.0	0.075	1.53	85.41
3.5	0.036	1.79	41.00
4.0	0.018	2.04	20.50
4.5	0.009	2.30	10.25
5.0	0.004	2.55	4.56
			705



MISSOURI POWER AND LIGHT DAM
0.10 HOUR UNIT HYDROGRAPH

MO. POWER AND LIGHT DAM

DETERMINATION OF PMS

1. Determine drainage area of the basin

   D.A. = 1.20 Sq. mi.

2. Determine PMP Index rainfall:

   Location of centroid of basin:

   Long. 91.9°; Lat.: 39.16°

   → PMP for 200 Sq. mi. & 24 hrs duration

   = 24.7" (from Fig 1, HMR NO 33)

3. Determine basin rainfall in terms of percentage of PMP Index rainfall for various durations:

   Location: Long. 91.9°; Lat. 39.16°

   ⇒ Zone 7

Duration (Hrs.)	Percent of Index rainfall (%)	Total rainfall (Inches)	Rainfall increments (Inches)	Duration of increment (Hrs.)
6	100	24.7	24.7	6
12	120	29.6	4.9	6
24	130	32.1	2.5	12

ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF
MO. POWER AND LIGHT DAM — JOB NO. 1223-001
100-YEAR FLOOD BY REGRESSION EQUATION — BY MAS — DATE 10-20-78

MO. POWER AND LIGHT DAM

100-YEAR FLOOD BY REGRESSION EQUATION

Regression equation for 100-year flood for Missouri:

$$Q_{100} = 85.1 A^{0.934} A^{-0.02} S^{0.576}$$

Where, A = drainage area in Sq. mi.

S = main channel slope ft./mi.

(Avg. slope between 0.1L & 0.85L)

For Mo. Power & Light Dam:

A = 769 acres = 1.20 Sq. mi

S = 28 ft./0.91 mi = 30.85 ft./mi

$$Q_{100} = 85.1 (1.20)^{0.934} (1.20)^{-0.02} (30.85)^{0.576}$$

$$= \underline{727 \text{ cfs}}$$

HEC1DB INPUT DATA

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
    1              A
    2              A                              DAM SAFETY INSPECTION - MISSOURI
    3              A                              MISSOURI POWER AND LIGHT DAM
    4              A                    PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING
    5              B    300       0         6         0         0         0         0         0         0         0
    6              R1     5
    7              J      1       2         1
    8              J1   1.0     0.5
    9              K      0       8                                                  1
   10              K1       INPUT PMP INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH
   11              M        1      -1      1.20                1.20      1.0
   12              P              24.70     100       120       130
   13              T                                                          0.85      0.07
   14              U      27
   15              U1    0.0      80.      280.      655.      970.     1139.     1060.      895.      680.      510.
   16              U1   385.     295.      220.      165.      125.       88.       60.       40.       22.       15.
   17              U1    10.       7.        5.        3.        2.        1.        0.
   18              X              0.        1
   19              K        1       8                                      2                 1
   20              K1       ROUTE HYDROGRAPH THROUGH MISSOURI POWER AND LIGHT DAM
   21              Y                                          1         1
   22              Y1       1                                                      -792.        -1
   23              Y4   792.00  793.00    794.00    795.67    796.00    798.00    800.00    805.00
   24              Y5     0.0     123.      345.      867.     1320.     7905.    18093.    53954.
   25              $S       0.      224.      330.      501.     1306.     3051.
   26              $E     772.      792.    795.67      800.      810.      820.
   27              $$792.00
   28              $D795.67
   29              K      99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	8
ROUTE HYDROGRAPH TO	8
END OF NETWORK	

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********************************

RUN  DATE= 78/10/24.
     TIME= 13.02.17.
```

DAM SAFETY INSPECTION - MISSOURI
MISSOURI POWER AND LIGHT DAM
PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING

JOB SPECIFICATION

NQ	NSAR	NMIN	IDAY	IHR	IMIN	METRC	TPLT	IPRT	MSTAN
500	0	6	0	0	0	0	0	0	0
			IOPER	NRT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIOS= 1.00 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT PMP INDEX PRECIPITATION AND RATIOS, INPUT SCS CN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	1.20	0.00	1.20	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.70	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	.85	.07	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 27

0.	80.	280.	655.	970.	1139.	1060.	895.	680.	510.
385.	295.	220.	165.	125.	88.	60.	40.	22.	15.
10.	7.	5.	3.	2.	1.	0.			

UNIT GRAPH TOTALS 7712. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

	0											
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

1.01	.06	1	.02	0.00	.02	0.	1.01	15.06	151	.38	.37	.01	2724.
1.01	.12	2	.02	0.00	.02	0.	1.01	15.12	152	.47	.46	.01	2747.
1.01	.18	3	.02	0.00	.02	0.	1.01	15.18	153	.56	.56	.01	2772.
1.01	.24	4	.02	0.00	.02	0.	1.01	15.24	154	.75	.74	.01	2821.
1.01	.30	5	.02	0.00	.02	0.	1.01	15.30	155	1.69	1.68	.01	2938.
1.01	.36	6	.02	0.00	.02	0.	1.01	15.36	156	3.00	3.00	.01	3231.
1.01	.42	7	.02	0.00	.02	0.	1.01	15.42	157	.94	.93	.01	3929.
1.01	.48	8	.02	0.00	.02	0.	1.01	15.48	158	.75	.74	.01	5143.
1.01	.54	9	.02	0.00	.02	0.	1.01	15.54	159	.47	.46	.01	6723.
1.01	1.00	10	.02	0.00	.02	0.	1.01	16.00	160	.38	.37	.01	7989.
1.01	1.06	11	.02	0.00	.02	0.	1.01	16.06	161	.35	.34	.01	8551.
1.01	1.12	12	.02	0.00	.02	0.	1.01	16.12	162	.35	.34	.01	8251.
1.01	1.18	13	.02	0.00	.02	0.	1.01	16.18	163	.35	.34	.01	7480.
1.01	1.24	14	.02	0.00	.02	0.	1.01	16.24	164	.35	.34	.01	6496.
1.01	1.30	15	.02	0.00	.02	0.	1.01	16.30	165	.35	.34	.01	5613.
1.01	1.36	16	.02	0.00	.02	0.	1.01	16.36	166	.35	.34	.01	4899.
1.01	1.42	17	.02	0.00	.02	0.	1.01	16.42	167	.35	.34	.01	4347.
1.01	1.48	18	.02	0.00	.02	0.	1.01	16.48	168	.35	.34	.01	3913.
1.01	1.54	19	.02	0.00	.02	0.	1.01	16.54	169	.35	.34	.01	3587.
1.01	2.00	20	.02	0.00	.02	0.	1.01	17.00	170	.35	.34	.01	3335.
1.01	2.06	21	.02	0.00	.02	0.	1.01	17.06	171	.27	.26	.01	3128.
1.01	2.12	22	.02	0.00	.02	0.	1.01	17.12	172	.27	.26	.01	2964.
1.01	2.18	23	.02	0.00	.02	0.	1.01	17.18	173	.27	.26	.01	2829.
1.01	2.24	24	.02	0.00	.02	0.	1.01	17.24	174	.27	.26	.01	2685.
1.01	2.30	25	.02	0.00	.02	0.	1.01	17.30	175	.27	.26	.01	2563.
1.01	2.36	26	.02	0.00	.02	0.	1.01	17.36	176	.27	.26	.01	2445.
1.01	2.42	27	.02	0.00	.02	0.	1.01	17.42	177	.27	.26	.01	2346.
1.01	2.48	28	.02	0.00	.02	0.	1.01	17.48	178	.27	.26	.01	2266.
1.01	2.54	29	.02	0.00	.02	0.	1.01	17.54	179	.27	.26	.01	2205.
1.01	3.00	30	.02	0.00	.02	0.	1.01	18.00	180	.27	.26	.01	2160.
1.01	3.06	31	.02	0.00	.02	0.	1.01	18.06	181	.02	.02	.01	2126.
1.01	3.12	32	.02	0.00	.02	0.	1.01	18.12	182	.02	.02	.01	2080.
1.01	3.18	33	.02	0.00	.02	0.	1.01	18.18	183	.02	.02	.01	1993.
1.01	3.24	34	.02	0.00	.02	0.	1.01	18.24	184	.02	.02	.01	1819.
1.01	3.30	35	.02	0.00	.02	0.	1.01	18.30	185	.02	.02	.01	1570.
1.01	3.36	36	.02	0.00	.02	0.	1.01	18.36	186	.02	.02	.01	1282.
1.01	3.42	37	.02	0.00	.02	0.	1.01	18.42	187	.02	.02	.01	1016.
1.01	3.48	38	.02	0.00	.02	0.	1.01	18.48	188	.02	.02	.01	792.
1.01	3.54	39	.02	0.00	.02	0.	1.01	18.54	189	.02	.02	.01	622.
1.01	4.00	40	.02	0.00	.02	0.	1.01	19.00	190	.02	.02	.01	495.
1.01	4.06	41	.02	0.00	.02	0.	1.01	19.06	191	.02	.02	.01	399.
1.01	4.12	42	.02	0.00	.02	0.	1.01	19.12	192	.02	.02	.01	326.
1.01	4.18	43	.02	0.00	.02	0.	1.01	19.18	193	.02	.02	.01	271.
1.01	4.24	44	.02	0.00	.02	0.	1.01	19.24	194	.02	.02	.01	230.
1.01	4.30	45	.02	0.00	.02	0.	1.01	19.30	195	.02	.02	.01	199.
1.01	4.36	46	.02	0.00	.02	0.	1.01	19.36	196	.02	.02	.01	177.
1.01	4.42	47	.02	0.00	.02	0.	1.01	19.42	197	.02	.02	.01	162.
1.01	4.48	48	.02	0.00	.02	0.	1.01	19.48	198	.02	.02	.01	153.
1.01	4.54	49	.02	0.00	.02	0.	1.01	19.54	199	.02	.02	.01	147.
1.01	5.00	50	.02	0.00	.02	0.	1.01	20.00	200	.02	.02	.01	143.
1.01	5.06	51	.02	0.00	.02	0.	1.01	20.06	201	.02	.02	.01	141.
1.01	5.12	52	.02	.00	.01	0.	1.01	20.12	202	.02	.02	.01	139.
1.01	5.18	53	.02	.01	.01	0.	1.01	20.18	203	.02	.02	.01	138.
1.01	5.24	54	.02	.01	.01	2.	1.01	20.24	204	.02	.02	.01	137.
1.01	5.30	55	.02	.01	.01	6.	1.01	20.30	205	.02	.02	.01	137.
1.01	5.36	56	.02	.01	.01	13.	1.01	20.36	206	.02	.02	.01	137.
1.01	5.42	57	.02	.01	.01	23.	1.01	20.42	207	.02	.02	.01	137.
1.01	5.48	58	.02	.01	.01	33.	1.01	20.48	208	.02	.02	.01	137.
1.01	5.54	59	.02	.01	.01	43.	1.01	20.54	209	.02	.02	.01	137.
1.01	6.00	60	.02	.01	.01	51.	1.01	21.00	210	.02	.02	.01	137.

1.01	6.06	61	.08	.08	.01	56.	1.01	21.06	211	.02	.02	.01	137.		
1.01	6.12	62	.08	.08	.01	66.	1.01	21.12	212	.02	.02	.01	137.		
1.01	6.18	63	.08	.08	.01	88.	1.01	21.18	213	.02	.02	.01	137.		
1.01	6.24	64	.08	.08	.01	133.	1.01	21.24	214	.02	.02	.01	137.		
1.01	6.30	65	.08	.08	.01	199.	1.01	21.30	215	.02	.02	.01	137.		
1.01	6.36	66	.08	.08	.01	276.	1.01	21.36	216	.02	.02	.01	137.		
1.01	6.42	67	.08	.08	.01	347.	1.01	21.42	217	.02	.02	.01	137.		
1.01	6.48	68	.08	.08	.01	406.	1.01	21.48	218	.02	.02	.01	137.		
1.01	6.54	69	.08	.08	.01	451.	1.01	21.54	219	.02	.02	.01	137.		
1.01	7.00	70	.08	.08	.01	485.	1.01	22.00	220	.02	.02	.01	137.		
1.01	7.06	71	.08	.08	.01	511.	1.01	22.06	221	.02	.02	.01	137.		
1.01	7.12	72	.08	.08	.01	530.	1.01	22.12	222	.02	.02	.01	137.		
1.01	7.18	73	.08	.08	.01	545.	1.01	22.18	223	.02	.02	.01	137.		
1.01	7.24	74	.08	.08	.01	556.	1.01	22.24	224	.02	.02	.01	137.		
1.01	7.30	75	.08	.08	.01	564.	1.01	22.30	225	.02	.02	.01	137.		
1.01	7.36	76	.08	.08	.01	570.	1.01	22.36	226	.02	.02	.01	137.		
1.01	7.42	77	.08	.08	.01	574.	1.01	22.42	227	.02	.02	.01	137.		
1.01	7.48	78	.08	.08	.01	577.	1.01	22.48	228	.02	.02	.01	137.		
1.01	7.54	79	.08	.08	.01	578.	1.01	22.54	229	.02	.02	.01	137.		
1.01	8.00	80	.08	.08	.01	579.	1.01	23.00	230	.02	.02	.01	137.		
1.01	8.06	81	.08	.08	.01	580.	1.01	23.06	231	.02	.02	.01	137.		
1.01	8.12	82	.08	.08	.01	580.	1.01	23.12	232	.02	.02	.01	137.		
1.01	8.18	83	.08	.08	.01	581.	1.01	23.18	233	.02	.02	.01	137.		
1.01	8.24	84	.08	.08	.01	581.	1.01	23.24	234	.02	.02	.01	137.		
1.01	8.30	85	.08	.08	.01	581.	1.01	23.30	235	.02	.02	.01	137.		
1.01	8.36	86	.08	.08	.01	581.	1.01	23.36	236	.02	.02	.01	137.		
1.01	8.42	87	.08	.08	.01	581.	1.01	23.42	237	.02	.02	.01	137.		
1.01	8.48	88	.08	.08	.01	581.	1.01	23.48	238	.02	.02	.01	137.		
1.01	8.54	89	.08	.08	.01	581.	1.01	23.54	239	.02	.02	.01	137.		
1.01	9.00	90	.08	.08	.01	581.	1.02	0.00	240	.02	.02	.01	137.		
1.01	9.06	91	.08	.08	.01	581.	1.02	.06	241	0.00	0.00	0.00	137.		
1.01	9.12	92	.08	.08	.01	581.	1.02	.12	242	0.00	0.00	0.00	135.		
1.01	9.18	93	.08	.08	.01	581.	1.02	.18	243	0.00	0.00	0.00	130.		
1.01	9.24	94	.08	.08	.01	581.	1.02	.24	244	0.00	0.00	0.00	119.		
1.01	9.30	95	.08	.08	.01	581.	1.02	.30	245	0.00	0.00	0.00	101.		
1.01	9.36	96	.08	.08	.01	581.	1.02	.36	246	0.00	0.00	0.00	81.		
1.01	9.42	97	.08	.08	.01	581.	1.02	.42	247	0.00	0.00	0.00	62.		
1.01	9.48	98	.08	.08	.01	581.	1.02	.48	248	0.00	0.00	0.00	47.		
1.01	9.54	99	.08	.08	.01	581.	1.02	.54	249	0.00	0.00	0.00	35.		
1.01	10.00	100	.08	.08	.01	581.	1.02	1.00	250	0.00	0.00	0.00	26.		
1.01	10.06	101	.08	.08	.01	581.	1.02	1.06	251	0.00	0.00	0.00	19.		
1.01	10.12	102	.08	.08	.01	581.	1.02	1.12	252	0.00	0.00	0.00	14.		
1.01	10.18	103	.08	.08	.01	581.	1.02	1.18	253	0.00	0.00	0.00	10.		
1.01	10.24	104	.08	.08	.01	581.	1.02	1.24	254	0.00	0.00	0.00	7.		
1.01	10.30	105	.08	.08	.01	581.	1.02	1.30	255	0.00	0.00	0.00	4.		
1.01	10.36	106	.08	.08	.01	581.	1.02	1.36	256	0.00	0.00	0.00	3.		
1.01	10.42	107	.08	.08	.01	581.	1.02	1.42	257	0.00	0.00	0.00	2.		
1.01	10.48	108	.08	.08	.01	581.	1.02	1.48	258	0.00	0.00	0.00	1.		
1.01	10.54	109	.08	.08	.01	581.	1.02	1.54	259	0.00	0.00	0.00	1.		
1.01	11.00	110	.08	.08	.01	581.	1.02	2.00	260	0.00	0.00	0.00	0.		
1.01	11.06	111	.08	.08	.01	581.	1.02	2.06	261	0.00	0.00	0.00	0.		
1.01	11.12	112	.08	.08	.01	581.	1.02	2.12	262	0.00	0.00	0.00	0.		
1.01	11.18	113	.08	.08	.01	581.	1.02	2.18	263	0.00	0.00	0.00	0.		
1.01	11.24	114	.08	.08	.01	581.	1.02	2.24	264	0.00	0.00	0.00	0.		
1.01	11.30	115	.08	.08	.01	581.	1.02	2.30	265	0.00	0.00	0.00	0.		
1.01	11.36	116	.08	.08	.01	581.	1.02	2.36	266	0.00	0.00	0.00	0.		
1.01	11.42	117	.08	.08	.01	581.	1.02	2.42	267	0.00	0.00	0.00	0.		
1.01	11.48	118	.08	.08	.01	581.	1.02	2.48	268	0.00	0.00	0.00	0.		
1.01	11.54	119	.08	.08	.01	581.	1.02	2.54	269	0.00	0.00	0.00	0.		
1.01	12.00	120	.08	.08	.01	581.	1.02	3.00	270	0.00	0.00	0.00	0.		

1.01	12.06	121	.25	.24	.01	581.	1.02	3.06	271	0.00	0.00	0.00	0.
1.01	12.12	122	.25	.24	.01	594.	1.02	3.12	272	0.00	0.00	0.00	0.
1.01	12.18	123	.25	.24	.01	607.	1.02	3.18	273	0.00	0.00	0.00	0.
1.01	12.24	124	.25	.24	.01	620.	1.02	3.24	274	0.00	0.00	0.00	0.
1.01	12.30	125	.25	.24	.01	633.	1.02	3.30	275	0.00	0.00	0.00	0.
1.01	12.36	126	.25	.24	.01	1095.	1.02	3.36	276	0.00	0.00	0.00	0.
1.01	12.42	127	.25	.24	.01	1270.	1.02	3.42	277	0.00	0.00	0.00	0.
1.01	12.48	128	.25	.24	.01	1417.	1.02	3.48	278	0.00	0.00	0.00	0.
1.01	12.54	129	.25	.24	.01	1529.	1.02	3.54	279	0.00	0.00	0.00	0.
1.01	13.00	130	.25	.24	.01	1613.	1.02	4.00	280	0.00	0.00	0.00	0.
1.01	13.06	131	.30	.29	.01	1677.	1.02	4.06	281	0.00	0.00	0.00	0.
1.01	13.12	132	.30	.29	.01	1729.	1.02	4.12	282	0.00	0.00	0.00	0.
1.01	13.18	133	.30	.29	.01	1773.	1.02	4.18	283	0.00	0.00	0.00	0.
1.01	13.24	134	.30	.29	.01	1809.	1.02	4.24	284	0.00	0.00	0.00	0.
1.01	13.30	135	.30	.29	.01	1839.	1.02	4.30	285	0.00	0.00	0.00	0.
1.01	13.36	136	.30	.29	.01	1864.	1.02	4.36	286	0.00	0.00	0.00	0.
1.01	13.42	137	.30	.29	.01	2000.	1.02	4.42	287	0.00	0.00	0.00	0.
1.01	13.48	138	.30	.29	.01	2091.	1.02	4.48	288	0.00	0.00	0.00	0.
1.01	13.54	139	.30	.29	.01	2128.	1.02	4.54	289	0.00	0.00	0.00	0.
1.01	14.00	140	.30	.29	.01	2156.	1.02	5.00	290	0.00	0.00	0.00	0.
1.01	14.06	141	.37	.36	.01	2177.	1.02	5.06	291	0.00	0.00	0.00	0.
1.01	14.12	142	.37	.36	.01	2194.	1.02	5.12	292	0.00	0.00	0.00	0.
1.01	14.18	143	.37	.36	.01	2231.	1.02	5.18	293	0.00	0.00	0.00	0.
1.01	14.24	144	.37	.36	.01	2288.	1.02	5.24	294	0.00	0.00	0.00	0.
1.01	14.30	145	.37	.36	.01	2366.	1.02	5.30	295	0.00	0.00	0.00	0.
1.01	14.36	146	.37	.36	.01	2455.	1.02	5.36	296	0.00	0.00	0.00	0.
1.01	14.42	147	.37	.36	.01	2537.	1.02	5.42	297	0.00	0.00	0.00	0.
1.01	14.48	148	.37	.36	.01	2605.	1.02	5.48	298	0.00	0.00	0.00	0.
1.01	14.54	149	.37	.36	.01	2656.	1.02	5.54	299	0.00	0.00	0.00	0.
1.01	15.00	150	.37	.36	.01	2695.	1.02	6.00	300	0.00	0.00	0.00	0.
									SUM	32.11	29.98	2.17	230924.
										(816.)	(761.)	(55.)	(6539.04)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8551.	3054.	962.	770.	230908.
CMS	242.	86.	27.	22.	6539.
INCHES		23.67	29.83	29.83	29.83
MM		601.24	757.76	757.76	757.76
AC-FT		1514.	1908.	1908.	1908.
THOUS CU M		1868.	2354.	2354.	2354.

HYDROGRAPH AT STA 6 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	2.	6.	13.	23.	33.	43.	51.
56.	66.	88.	133.	199.	276.	347.	406.	451.	485.
511.	530.	545.	556.	564.	570.	574.	577.	578.	579.
580.	580.	581.	581.	581.	581.	581.	581.	581.	581.
581.	581.	581.	581.	581.	581.	581.	581.	581.	581.
581.	581.	581.	581.	581.	581.	581.	581.	581.	581.
581.	581.	581.	581.	581.	581.	581.	581.	581.	581.
581.	594.	640.	748.	908.	1095.	1270.	1417.	1529.	1613.
1677.	1729.	1773.	1839.	1907.	1978.	2040.	2091.	2128.	2156.
2177.	2194.	2231.	2288.	2366.	2455.	2537.	2605.	2656.	2695.

2724.	2747.	2772.	2821.	2938.	3231.	3929.	5145.	6723.	7989.
8551.	8251.	7480.	6496.	5613.	4899.	4347.	3913.	3587.	3335.
3128.	2964.	2823.	2685.	2563.	2485.	2346.	2266.	2205.	2160.
2126.	2080.	1993.	1819.	1570.	1282.	1016.	792.	622.	495.
399.	326.	271.	230.	199.	177.	162.	153.	147.	143.
141.	139.	138.	137.	137.	137.	137.	137.	137.	137.
137.	137.	137.	137.	137.	137.	137.	137.	137.	137.
137.	137.	137.	137.	137.	137.	137.	137.	137.	137.
137.	137.	137.	137.	137.	137.	137.	137.	137.	137.
137.	135.	130.	119.	101.	81.	62.	47.	35.	26.
19.	14.	10.	7.	4.	3.	2.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8551.	3054.	962.	770.	230908.
CMS	242.	86.	27.	22.	6539.
INCHES		23.67	29.83	29.83	29.83
MM		601.24	757.76	757.76	757.76
AC-FT		1514.	1908.	1908.	1908.
THOUS CU M		1868.	2354.	2354.	2354.

HYDROGRAPH AT STA H FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	3.	7.	11.	17.	21.	25.
28.	33.	44.	67.	100.	138.	173.	203.	226.	243.
255.	265.	273.	278.	282.	285.	287.	288.	289.	290.
290.	290.	290.	290.	290.	290.	290.	290.	290.	290.
290.	290.	290.	290.	290.	290.	290.	290.	290.	290.
290.	290.	290.	290.	290.	290.	290.	290.	290.	290.
290.	290.	290.	290.	290.	290.	290.	290.	290.	290.
290.	297.	320.	374.	454.	548.	635.	709.	765.	807.
838.	865.	890.	919.	954.	989.	1020.	1046.	1064.	1078.
1088.	1099.	1115.	1144.	1183.	1228.	1268.	1302.	1328.	1348.
1362.	1373.	1386.	1411.	1469.	1615.	1965.	2571.	3361.	3995.
4276.	4125.	3740.	3248.	2807.	2450.	2174.	1957.	1794.	1667.
1564.	1482.	1411.	1343.	1281.	1222.	1173.	1133.	1102.	1080.
1063.	1040.	997.	909.	785.	641.	508.	396.	311.	247.
200.	163.	136.	115.	100.	89.	81.	76.	72.	72.
70.	70.	69.	69.	68.	68.	68.	68.	68.	68.
68.	68.	68.	68.	68.	68.	68.	68.	68.	68.
68.	68.	68.	68.	68.	68.	68.	68.	68.	68.
68.	68.	68.	68.	68.	68.	68.	68.	68.	68.
68.	68.	65.	59.	51.	41.	31.	23.	17.	13.
9.	7.	5.	3.	2.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4276.	1527.	481.	385.	115454.

PMF FLOOD ROUTING

CMS	121.	43.	14.	11.	3269.
INCHES		11.84	14.92	14.92	14.92
MM		300.62	378.88	378.88	378.88
AC-FT		757.	954.	954.	954.
THOUS CU M		934.	1177.	1177.	1177.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH MISSOURI POWER AND LIGHT DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-792.	-1

STAGE	792.0	793.0	794.0	795.7	796.0	798.0	800.0	805.0
FLOW	0.	123.	345.	867.	1320.	7905.	18093.	53954.
CAPACITY=	0.	224.	330.	501.	1306.	3051.		
ELEVATION=	772.	792.	796.	800.	810.	820.		

CREL	SPWID	COOW	EXPW	ELEVI	COOL	CAREA	EXPL
792.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
795.7	0.0	0.0	0.

STATION 8, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	2.	3.	5.
6.	8.	11.	14.	19.	27.	37.	49.	62.	76.
90.	105.	120.	145.	170.	195.	218.	240.	261.	280.
299.	316.	332.	348.	368.	387.	403.	418.	432.	445.
457.	467.	477.	486.	494.	502.	508.	515.	520.	525.
530.	535.	539.	542.	545.	549.	551.	554.	556.	558.
560.	562.	564.	565.	566.	568.	569.	570.	571.	572.
572.	574.	577.	587.	608.	642.	688.	744.	807.	882.
1073.	1252.	1407.	1613.	1746.	1847.	1930.	2000.	2056.	2100.
2134.	2161.	2189.	2225.	2277.	2346.	2423.	2499.	2566.	2622.
2667.	2702.	2731.	2765.	2820.	2959.	3277.	3922.	4952.	6184.

7253.	7841.	7854.	7410.	6715.	5968.	5279.	4690.	4209.	3826.
3521.	3277.	3081.	2913.	2765.	2631.	2510.	2405.	2318.	2249.
2194.	2147.	2091.	1996.	1841.	1629.	1383.	1230.	1099.	963.
856.	813.	769.	725.	681.	639.	599.	561.	526.	493.
463.	436.	410.	387.	365.	346.	333.	321.	309.	299.
289.	279.	271.	262.	255.	247.	240.	234.	228.	222.
217.	212.	207.	203.	199.	195.	192.	188.	185.	182.
179.	177.	174.	172.	170.	168.	166.	164.	162.	161.
159.	158.	156.	154.	151.	148.	143.	138.	132.	125.
121.	117.	114.	110.	106.	103.	99.	96.	93.	89.
86.	83.	80.	78.	75.	72.	70.	67.	65.	63.
61.	59.	57.	55.	53.	51.	49.	47.	46.	44.
43.	41.	40.	38.	37.	36.	35.	33.	32.	31.
30.	29.	28.	27.	26.	25.	24.	23.	23.	22.

STORAGE

224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	225.	225.
226.	226.	227.	227.	229.	230.	233.	235.	238.	242.
245.	249.	252.	256.	259.	262.	265.	268.	271.	273.
276.	278.	280.	282.	284.	286.	287.	289.	290.	291.
292.	293.	294.	295.	296.	296.	297.	297.	298.	298.
299.	299.	300.	300.	300.	301.	301.	301.	301.	301.
302.	302.	302.	302.	302.	302.	302.	303.	303.	303.
303.	303.	303.	304.	306.	309.	313.	319.	324.	330.
336.	340.	344.	347.	348.	349.	350.	351.	352.	352.
353.	353.	353.	354.	355.	355.	356.	357.	358.	359.
359.	360.	360.	360.	361.	363.	366.	374.	387.	401.
414.	421.	421.	416.	408.	399.	391.	383.	378.	373.
369.	367.	364.	362.	360.	359.	357.	356.	355.	354.
354.	353.	352.	351.	349.	347.	344.	340.	337.	333.
320.	325.	321.	317.	313.	309.	305.	302.	298.	295.
293.	290.	288.	286.	284.	282.	280.	279.	277.	276.
274.	273.	272.	271.	270.	269.	268.	267.	267.	266.
265.	264.	264.	263.	263.	262.	262.	261.	261.	261.
260.	260.	260.	259.	259.	259.	258.	258.	258.	258.
258.	257.	257.	257.	257.	256.	255.	255.	254.	253.
252.	252.	251.	250.	249.	248.	247.	247.	246.	245.
244.	244.	243.	242.	242.	241.	240.	240.	239.	239.
238.	238.	237.	237.	236.	236.	236.	235.	235.	234.
234.	234.	233.	233.	233.	232.	232.	232.	232.	231.
231.	231.	231.	230.	230.	230.	230.	230.	229.	229.

STAGE

792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.1	792.1	792.1	792.1	792.2	792.2	792.3	792.4	792.5	792.6
792.7	792.9	793.0	793.1	793.2	793.3	793.4	793.5	793.6	793.7
793.8	793.9	793.9	794.0	794.1	794.1	794.2	794.2	794.3	794.3
794.4	794.4	794.4	794.5	794.5	794.5	794.5	794.5	794.6	794.6
794.6	794.6	794.6	794.6	794.6	794.7	794.7	794.7	794.7	794.7
794.7	794.7	794.7	794.7	794.7	794.7	794.7	794.7	794.7	794.7

794.7	794.7	794.7	794.8	794.8	794.9	795.1	795.3	795.5	795.7
795.8	795.9	796.0	796.1	796.1	796.2	796.2	796.2	796.2	796.2
796.2	796.3	796.3	796.3	796.3	796.3	796.3	796.4	796.4	796.4
796.4	796.4	796.4	796.4	796.5	796.5	796.6	796.8	797.1	797.5
797.8	798.0	798.0	797.8	797.6	797.4	797.2	797.0	796.9	796.8
796.7	796.6	796.5	796.5	796.4	796.4	796.4	796.3	796.3	796.3
796.3	796.3	796.2	796.2	796.2	796.1	796.0	795.9	795.8	795.7
795.6	795.5	795.4	795.2	795.1	794.9	794.8	794.7	794.6	794.5
794.4	794.3	794.2	794.1	794.1	794.0	793.9	793.9	793.8	793.8
793.7	793.7	793.7	793.6	793.6	793.6	793.5	793.5	793.5	793.4
793.4	793.4	793.4	793.4	793.3	793.3	793.3	793.3	793.3	793.3
793.3	793.2	793.2	793.2	793.2	793.2	793.2	793.2	793.2	793.2
793.2	793.2-	793.1	793.1	793.1	793.1	793.1	793.1	793.0	793.0
793.0	793.0	792.9	792.9	792.9	792.8	792.8	792.8	792.8	792.7
792.7	792.7	792.7	792.6	792.6	792.6	792.6	792.5	792.5	792.5
792.5	792.5	792.5	792.4	792.4	792.4	792.4	792.4	792.4	792.4
792.3	792.3	792.3	792.3	792.3	792.3	792.3	792.3	792.3	792.3
792.2	792.2	792.2	792.2	792.2	792.2	792.2	792.2	792.2	792.2

PEAK OUTFLOW IS 7854. AT TIME 16.30 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7854.	3011.	959.	768.	230286.
CMS	222.	85.	27.	22.	6521.
INCHES		23.34	29.75	29.75	29.75
MM		592.92	755.69	755.72	755.72
AC-FT		1493.	1903.	1903.	1903.
THOUS CU M		1842.	2347.	2348.	2348.

MAXIMUM STORAGE = 421.

ONE-HALF PMF FLOOD ROUTING

DVN

STATION B, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	2.	2.
3.	4.	5.	7.	10.	13.	18.	24.	31.	38.
45.	53.	60.	68.	75.	82.	89.	96.	103.	109.
115.	121.	131.	140.	150.	158.	166.	174.	181.	188.
194.	200.	206.	211.	216.	220.	225.	229.	233.	236.
240.	243.	246.	248.	251.	253.	256.	258.	260.	262.
263.	265.	267.	268.	270.	271.	272.	273.	274.	275.
276.	277.	279.	283.	291.	304.	322.	344.	377.	412.
447.	481.	515.	549.	582.	615.	648.	681.	713.	744.
773.	800.	827.	853.	903.	979.	1047.	1106.	1157.	1202.
1240.	1271.	1298.	1326.	1384.	1465.	1632.	1958.	2475.	3091.
3628.	3921.	3927.	3705.	3358.	2984.	2639.	2345.	2104.	1913.
1760.	1639.	1540.	1457.	1382.	1318.	1288.	1255.	1221.	1189.
1160.	1133.	1105.	1067.	1013.	938.	860.	825.	785.	741.
697.	653.	610.	568.	529.	492.	457.	424.	395.	367.
343.	326.	310.	295.	281.	268.	256.	244.	233.	223.
214.	205.	196.	188.	181.	174.	168.	161.	156.	150.
145.	141.	136.	132.	128.	124.	122.	120.	118.	116.
115.	113.	112.	110.	109.	107.	106.	105.	103.	102.
101.	100.	99.	97.	96.	94.	92.	90.	88.	85.
82.	80.	77.	75.	72.	70.	67.	65.	63.	61.
59.	57.	55.	53.	51.	49.	48.	46.	44.	43.
41.	40.	38.	37.	36.	35.	33.	32.	31.	30.
29.	28.	27.	26.	25.	24.	24.	23.	22.	21.
20.	20.	19.	18.	18.	17.	17.	16.	15.	15.

STORAGE

224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	224.
224.	224.	224.	224.	224.	224.	224.	224.	224.	225.
225.	225.	225.	226.	226.	227.	228.	230.	231.	233.
235.	236.	238.	240.	242.	243.	245.	247.	248.	250.
251.	253.	254.	255.	256.	257.	259.	260.	260.	261.
262.	263.	264.	264.	265.	266.	266.	267.	267.	268.
268.	268.	269.	269.	270.	270.	270.	270.	271.	271.
271.	271.	272.	272.	272.	272.	272.	272.	273.	273.
273.	273.	273.	274.	275.	276.	279.	282.	285.	288.
291.	294.	298.	301.	304.	307.	310.	313.	316.	319.
321.	324.	326.	329.	331.	333.	335.	337.	338.	340.
341.	342.	342.	343.	344.	345.	347.	351.	357.	364.
371.	374.	374.	372.	367.	363.	359.	355.	352.	350.
348.	347.	346.	345.	344.	343.	342.	341.	340.	339.
338.	338.	337.	336.	334.	332.	329.	326.	322.	318.
314.	310.	306.	302.	299.	295.	292.	289.	286.	284.
281.	279.	277.	275.	273.	272.	270.	269.	267.	266.

265.	264.	262.	261.	260.	260.	259.	258.	257.	256.
256.	255.	255.	254.	254.	253.	253.	252.	252.	251.
251.	251.	250.	250.	250.	249.	249.	249.	248.	248.
248.	247.	247.	247.	247.	246.	246.	245.	245.	244.
243.	243.	242.	242.	241.	240.	[illegible]	239.	239.	238.
238.	237.	237.	236.	236.	236.	235.	235.	234.	234.
234.	233.	233.	233.	232.	232.	232.	232.	231.	231.
231.	231.	230.	230.	230.	230.	230.	229.	229.	229.
229.	229.	228.	228.	228.	228.	228.	228.	228.	227.

STAGE

792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0	792.0
792.0	792.0	792.0	792.1	792.1	792.1	792.1	792.2	792.3	792.3
792.4	792.4	792.5	792.5	792.6	792.7	792.7	792.8	792.8	792.9
792.9	793.0	793.0	793.1	793.1	793.2	793.2	793.2	793.3	793.3
793.3	793.3	793.4	793.4	793.4	793.4	793.5	793.5	793.5	793.5
793.5	793.5	793.6	793.6	793.6	793.6	793.6	793.6	793.6	793.6
793.6	793.6	793.6	793.7	793.7	793.7	793.7	793.7	793.7	793.7
793.7	793.7	793.7	793.7	793.8	793.8	793.9	794.0	794.1	794.2
794.3	794.4	794.5	794.7	794.8	794.9	795.0	795.1	795.2	795.3
795.4	795.5	795.5	795.6	795.7	795.8	795.8	795.8	795.9	795.9
795.9	796.0	796.0	796.0	796.0	796.0	796.1	796.2	796.4	796.5
796.7	796.8	796.8	796.7	796.6	796.5	796.4	796.3	796.2	796.2
796.1	796.1	796.1	796.0	796.0	796.0	796.0	796.0	795.9	795.9
795.9	795.9	795.8	795.8	795.8	795.7	795.6	795.5	795.4	795.3
795.1	795.0	794.8	794.7	794.6	794.5	794.4	794.3	794.2	794.1
794.0	793.9	793.8	793.8	793.7	793.7	793.6	793.5	793.5	793.5
793.4	793.4	793.3	793.3	793.3	793.2	793.2	793.2	793.1	793.1
793.1	793.1	793.1	793.0	793.0	793.0	793.0	793.0	793.0	792.9
792.9	792.9	792.9	792.9	792.9	792.9	792.9	792.9	792.8	792.8
792.8	792.8	792.8	792.8	792.8	792.8	792.7	792.7	792.7	792.7
792.7	792.6	792.6	792.6	792.6	792.6	792.5	792.5	792.5	792.5
792.5	792.5	792.4	792.4	792.4	792.4	792.4	792.4	792.4	792.3
792.3	792.3	792.3	792.3	792.3	792.3	792.3	792.3	792.3	792.2
792.2	792.2	792.2	792.2	792.2	792.2	792.2	792.2	792.2	792.2
792.2	792.2	792.2	792.1	792.1	792.1	792.1	792.1	792.1	792.1

PEAK OUTFLOW IS 3927. AT TIME 16.30 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3927.	1458.	479.	383.	115034.
CMS	111.	41.	14.	11.	3257.
INCHES		11.30	14.86	14.86	14.86
MM		287.10	377.49	377.50	377.50
AC-FT		723.	951.	951.	951.
THOUS CU M		892.	1173.	1173.	1173.

MAXIMUM STORAGE = 374.

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .50
HYDROGRAPH AT	A	1.20	1	8551.	4276.
		(3.11)		(242.14)(	121.07)(
ROUTED TO	A	1.20	1	7854.	3927.
		(3.11)		(222.39)(	111.19)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	792.00	792.00	795.67
STORAGE	224.	224.	330.
OUTFLOW	0.	0.	867.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	797.98	2.31	421.	7854.	6.10	16.50	0.00
.59	796.79	1.12	374.	5927.	5.67	16.33	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
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PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	8
ROUTE HYDROGRAPH TO	8
END OF NETWORK	

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 3 AUG 78
****

RUN DATE= 78/10/26.
TIME= 08.34.06.

DAM SAFETY INSPECTION - MISSOURI
MISSOURI POWER AND LIGHT DAM
PERCENT OF PMF DETERMINATION AND ROUTING

JOB SPECIFICATION

NO	NWT	NMIN	IDAY	IHR	IMIN	METRIC	IPLT	IPRT	NSTAN
300	0	6	0	0	0		0	4	0

JPER	NRT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIOS= 1

RTIOS= .10 .15 .20 .25 .30 .35 .40 .45 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT FOR INDEX PRECIPITATION AND RATIOS, INPUT SCS DA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	1.20	0.00	1.20	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PXS	P6	P12	P24	P48	P72	P96
0.00	24.70	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	.85	.07	0.00	0.00

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

0 RAINFALL-EXCESS-PERIOD FLOW

MO,DA	HR,MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO,DA	HR,MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	32.11	29.94	2.17	230924.
										(816.)(761.)(55.)(6539.04)			

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH MISSOURI POWER AND LIGHT DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	IPRT	INAME	ISTAGE	IAUTO
8	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-792.	-1

STAGE	792.0	795.0	798.0	795.7	798.0	798.0	800.0	805.0
FLOW	0.	123.	345.	807.	1300.	7905.	18093.	53950.
CAPACITY=	0.	224.	330.	501.	1506.	5951.		
ELEVATION=	772.	792.	798.	800.	810.	820.		

CREL	SPILD	COQA	EXPA	ELEVL	COQL	CAREA	EXPL
792.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
795.7	0.0	0.0	0.

PEAK OUTFLOW IS 435. AT TIME 16.70 HOURS

PEAK OUTFLOW IS 702. AT TIME 16.60 HOURS

PEAK OUTFLOW IS 1072. AT TIME 16.50 HOURS

PEAK OUTFLOW IS 1693. AT TIME 16.40 HOURS

PEAK OUTFLOW IS 2259. AT TIME 16.30 HOURS

PEAK OUTFLOW IS 2722. AT TIME 16.30 HOURS

PEAK OUTFLOW IS 3135. AT TIME 16.30 HOURS

PEAK OUTFLOW IS 3533. AT TIME 16.30 HOURS

PEAK OUTFLOW IS 3927. AT TIME 16.30 HOURS

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .10	RATIO 2 .15	RATIO 3 .20	RATIO 4 .25	RATIO 5 .30	RATIO 6 .35	RATIO 7 .40	RATIO 8 .45	RATIO 9 .50
HYDROGRAPH AT	A	1.20	1	855.	1283.	1710.	2138.	2565.	2993.	3420.	3848.	4276.
	(	3.11)	(	24.21)(	36.32)(	48.43)(	60.50)(	72.64)(	84.75)(	96.86)(	108.96)(	121.07)
ROUTED TO	A	1.20	1	435.	772.	1172.	1695.	2259.	2722.	3145.	3533.	3927.
	(	3.11)	(	12.32)(	19.88)(	33.37)(	47.93)(	63.97)(	77.09)(	88.77)(	100.03)(	111.19)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	792.00	792.00	795.67
STORAGE	224.	224.	330.
OUTFLOW	0.	0.	867.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	794.29	0.00	299.	435.	0.00	16.70	0.00
.15	795.14	0.00	315.	702.	0.00	16.60	0.00
.20	795.82	.15	336.	1072.	.70	16.50	0.00
.25	796.11	.44	308.	1693.	1.30	16.40	0.00
.30	796.29	.62	354.	2254.	1.80	16.30	0.00
.35	796.43	.76	360.	2722.	2.20	16.30	0.00
.40	796.55	.88	365.	3135.	3.10	16.30	0.00
.45	796.67	1.00	370.	3533.	3.70	16.30	0.00
.50	796.79	1.12	374.	3927.	4.20	16.30	0.00

END

DATE
FILMED

11-81

DTIC